coutume de définir le rendement d'un foyer de lumière par le rapport de l'énergie située dans la partie visible du spectre à l'énergie totale rayonnée par le foyer. Sans insister sur ce que cette définition a de défectueux (je traiterai prochainement cette question dans la *Revue générale des Sciences*), je rappellerai qu'on mesure d'ordinaire le rendement en recevant successivement sur un radiomètre quelconque (pile de Melloni, bolomètre, radiomicromètre de Boys) la radiation totale du foyer, et la radiation qui a traversé une certaine épaisseur d'eau ; on admet que les radiations obscures ont été retenues, et on fait le quotient de ces deux quantités. Aucun physicien, je suppose, ne croit que l'absorption par l'eau commence à l'endroit précis où cesse la vision, et devient immédiatement totale, mais on pense en général que le résultat ainsi obtenu est assez approché.

Or nous pouvons déterminer directement le rendement photogénique d'une source en mesurant la superficie des courbes d'énergie rayonnante visible et invisible. En partant des nombres de M. Langley, on trouve ainsi, pour le rendement d'une lampe à gaz une valeur comprise entre 1 et 2 pour cent. D'autre part, les recherches de M. Knut Ångström ont montré que l'absorption par l'eau est presque nulle pour $\lambda = 1\mu$, et n'est totale qu'à partir de $\lambda = 2\mu$ environ. Une couche épaisse d'eau laisse passer près de 10 pour cent de l'énergie rayonnante invisible. La méthode ordinaire donnerait donc, pour le rendement d'une lampe à gaz, 11 à 12 pour cent, c'est à dire une quantité six fois trop forte.

Je ne quitterai pas ce sujet sans faire remarquer le singulier usage en vertu duquel la puissance de la radiation solaire est rapportée à la *minute*, tandis que toutes les puissances possibles—cheval, *horse-power*, watt, ainsi que toutes les radiations—sont exprimées par rapport à la seconde. Il serait temps de faire disparaître cette anomalie.

Ch. Ed. Guillaume.

Pavillon de Breteuil, Sèvres, France,
25 septembre, 1891.

Weather Cycles.

With reference to this most interesting question, may I be allowed to call attention to the following figures ? Having had to consult Dr. Rutty's "Natural History of Dublin," 1772, vol. ii., I casually found on p. 353 of that volume, in his remarkable detailed registry of the weather in Dublin for a long series of years, the following remark : "It has been remarked that the following years were memorable for great frosts in England, viz. 1638, 1661, 1684, 1708, 1716, 1739." Now the intervals between these dates are 23, 23, 24, 8, 23. He further remarks, on p. 368 :—"It is to be observed that whereas since the great frost of 1739, until the latter end of the present summer, 1744, we had generally an unusual prevalence of dry weather, in autumn our usual wet weather returned." It may be remarked that the interval of 23 years is about double the sun-spot period, and furthermore that the years mentioned by Rutty correspond roughly with years of sun-spot minima or maxima as given in Wolf's Catalogue, mentioned by Guillemin in his work "Le Ciel" (1877), p. 104. This correspondence would appear as follows :—

Sun-spot Year.	Interval.	Great colds.	Interval.
1639·5 min.		1638	
	20·5		23
1660 min.		1661	
	25		23
1685 min.		1684	
	20·5		24
1705·5 min.		1708	
	12·5		8
1718 min.		1716	
	20·7		23
1738·7 min.		1739	
	16·8 }		15 }
1755·5 max.	} 22·8	1754	} 23
	6 0 }		8 }
1761·5 max.		1762	

J. P. O'Reilly.

Royal College of Science for Ireland, Stephen's Green,
Dublin, September 25.

Occurrence of the Ringed Snake in the Sea.

The readiness with which the British snake (*Tropidonotus natrix*) will enter fresh water is well known. Its occurrence in the sea seems anomalous, and therefore I venture to submit the following details.

The specimen in question was seen on September 7, from a small boat on the east coast of the Isle of Wight, while about a thousand yards distant from the shore, and about midway between Shanklin and Luccombe Chines. When first seen it was swimming straight out to sea—viz. in an easterly direction. The sea was calm and a strong current was flowing from the south, so that the creature was swimming across the current. At first it took no notice of the boat, but as the boat was rowed towards it, it changed its course and swam directly away from the boat. It was soon captured, and found to be uninjured and in good condition. Upon dissection it proved to be a male ; the entire alimentary canal was absolutely empty. The internal organs were free from disease or other abnormality. It measured 33 inches in length. It is most probable that this snake entered the sea about a mile from where it was obtained, as the beach is bounded by almost perpendicular cliffs, some 300 feet high, at that place.

J. Cowper.

A Rare Phenomenon.

Mr. Wilson's letter in your issue of September 24 (p. 494), recalls what I myself saw on the same evening. On Friday, the 11th, I was returning with a friend to town after a day's ramble in Epping Forest. We caught the 8.36 p.m. train at Epping, which is due at Woodford at 8.59, and was, I think, only a few minutes late. Just as the train was nearing Woodford Station, my friend and myself simultaneously noticed a luminous band, such as that observed by Mr. Wilson, and extending from the horizon almost to the zenith. Our first unreflecting thought was to refer it to the revolving light at the Naval Exhibition, only it did not revolve, and the direction was quite wrong. The fact that both of us thought of this is indicative of the appearance which the luminous beam bore. The night was clear and starlit, and I observed that the point in the horizon from which the beam rose was almost under the Great Bear, but a little to the left as I faced it. We saw it only for a minute or two before it was hidden from us by the shed of Woodford Station, in which station we stayed for what seemed a long while. When we got into the open country again, the phenomenon had disappeared. I may add, that my own eye being unfortunately defective for red, I asked my companion if he noticed any red tinge in the light, and he answered that it seemed quite white.

Burlington House. Herbert Rix.

The narrow luminous band described in Nature, September 24 (p. 494) was seen here on Friday, the 11th inst., between 8.30 and 9 p.m., at the same time at which it was seen by Mr. Wilson in the county Westmeath, but about twenty-two hours later than it was seen by Prof. Copeland in Aberdeenshire. It passed close south of Cassiopeia, and nearly through the zenith. Half an hour later it had drifted 8° or 10° southward, and had become very faint.

There can be little doubt that the very rapidly moving "comet" seen by Mr. Eddie at Grahamstown, South Africa, on October 27, 1890, was a phenomenon of this kind.

J. L. E. Dreyer.

The Observatory, Armagh, September 28.

The Heights of Auroras.

The rare part of the phenomena described by your correspondents is the extreme narrowness of the auroral arches seen on the 10th in the north of Scotland, and on the 11th at Ryde. I take all the other descriptions on the 11th to refer to one arch —a different one from that seen at Ryde ; and it was a much wider one, and therefore less unusual, its width having been about 5° as seen here. Your correspondents do not give its width, except that, as seen from Nottingham, it was evidently very broad, and is not stated to have been an arch at all, though I should suppose it was one. The observation at Nottingham Forest, compared with those further north, gives a good opportunity for ascertaining the height of the top of the aurora ; but, as Mr. A. Marshall has not given the altitude of the base of the aurora as seen from Nottingham, there are no materials for cal-

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culating the height of that. I made several observations of the position of the central line of the arch. I might specify that at 9.25 it was at R.A. 20h. 42m., Decl. $+ 33\frac{1}{2}^\circ$, and R.A. 0h. 43m., Decl. $+ 33^\circ$, and it moved very slowly.

Is it not time some systematic effort was made to calculate the heights of auroras? A good many observations have been made on this point, showing great variation in height; and yet, beyond the conclusion that it seems probable they may be seen at lower elevations nearer the magnetic pole than elsewhere, we know nothing as to whether they vary in height with the place, the time, or the nature of the auroras. Now is the time, seeing that auroras appear to be becoming more numerous than they have been for many years past. T. W. BACKHOUSE.

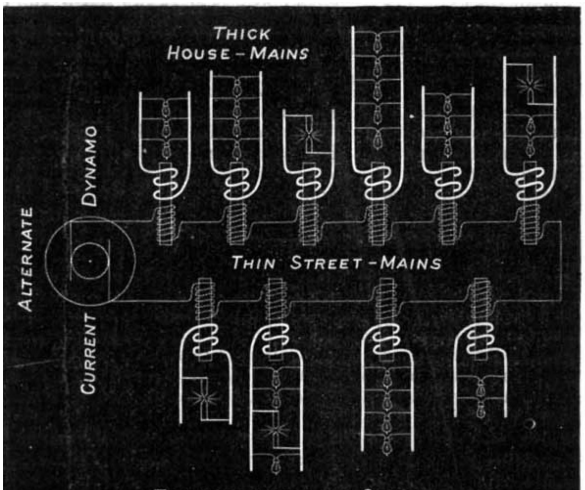
West Hendon House, Sunderland, October 5.

SOME NOTES ON THE FRANKFORT INTERNATIONAL ELECTRICAL EXHIBITION.[1]

III.

From One Hundred to Twenty Thousand Volts.

THE incandescent lamp having, by 1885, reached a fair degree of perfection, it appeared that the one need still remaining, in connection with the distribution of the electric light over a large area, would be supplied by the use of transformers. For a transformer with many convolutions of fine insulated wire on one coil, and a few convolutions of thick insulated wire on the other, would transform a large pressure and small current into a small pressure and large current; hence, if such a transformer were placed in each house, it would be possible to light up even a scattered district by a comparatively fine wire from a central station, whereas previously it had seemed that it would be necessary to use copper conductors many square inches in cross-section to light many houses even when at no great distance from one another.



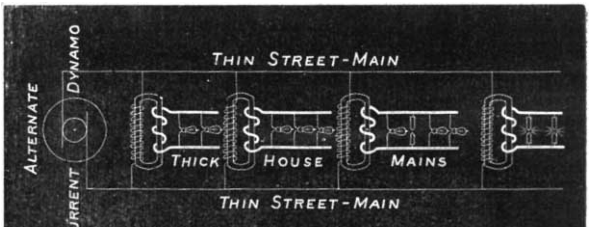
TRANSFORMERS IN SERIES
GAULARD AND GIBBS' ORIGINAL ARRANGEMENT.
FIG. 2

Hence, in the autumn of 1885 we find Messrs. Gaulard and Gibbs making preparations at the Grosvenor Gallery, Bond Street, for establishing there the pioneer central station for London.

But the method they adopted was that of placing the transformers in series, as seen in Fig. 2, and this system has the great disadvantage that the brightness of the electric lamps in a house cannot be kept automatically constant when other lamps in the same house are turned on or off. There are, of course, two conditions to be fulfilled in electric lighting: one, that turning on or off lamps in one house shall not affect the brightness of the lamps in any other house; the other, that turning on or off lamps in one room shall not affect the brightness of the lamps in any other room of the same house. With transformers in series, the first condition is satisfied by keeping the alternating current which passes through the fine wire or *primary coil* of the transformer perfectly constant; but this does not render the potential difference between the wires from the *secondary circuit*, or house mains, independent of the current in this secondary circuit—that is, independent of the number of lamps turned on in the house. Consequently, the series arrangement of transformers adopted by Messrs. Gaulard and Gibbs, while rendering the lamps in one house independent of those in another, did not attain the same result for lamps in different rooms of the same house.

Complaints, therefore, became general. Various unsuccessful devices were tried to remedy this evil, when an application was received from Mr. Sebastian Ziani de Ferranti to be allowed to try a transformer which he had designed. The application was accepted, for Mr. Ferranti, although quite young, was already known as having constructed an ingenious alternate-current dynamo, and in February 1886 the charge of the Grosvenor Gallery central station passed over into Mr. Ferranti's hands.

The new engineer recommended that the system of placing the transformers in series should be totally discarded, and that a parallel arrangement should be adopted in its place, as in Fig. 3, because a well-made transformer had this important property—that if the potential difference at the terminals of the primary coil were kept constant, the potential difference between the terminals of the secondary coil would also remain nearly constant whatever were the current passing through this circuit; so that if the pressure between the street mains were always kept the same, the brightness of the lamps would hardly be affected either by turning on or off lamps in the same or in any other house.



TRANSFORMERS IN PARALLEL
ARRANGEMENT NOW ADOPTED
FIG 3..

Placing the transformers in parallel, however, would necessitate working at a low pressure, said the press, and would rob the transformer system of all its value, for "it is surely not proposed for one moment to work a parallel system where the primary has a difference of potential of 2000 volts." However, that is exactly what Mr. Ferranti not only proposed to do, but what he actually carried out on a large scale, so that his mains by 1888 stretched from Regent's Park to the Thames, and from Chancery Lane to Hyde Park, supplying current to some 20,000 glow-lamps. The Board of Trade had made regulations, about 200 volts being the maximum pressure permitted in a house; Parliament had passed the Electric Lighting Act of 1882, containing clauses rendering the development of the electric lighting industry well nigh commercially impossible; but Mr. Ferranti overcame all these legalities by bridging his mains from house-top to house-top, instead

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[1] Continued from p. 524.

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